STATEMENT OF WORK # *VITA-170127-01*-CAI
SUBMITTED BY
SUPPLIER
AS SUBCONTRACTOR TO
COMPUTER AID, INC.
FOR
CONTRACT NUMBER VA-130620-CAI
BETWEEN THE COMMONWEALTH OF VIRGINIA
AND
COMPUTER AID, INC.

This Statement of Work is issued on behalf of the *Virginia Geographic Information Network / Virginia Information Technologies Agency*, hereinafter referred to as "Authorized User." The objective of the project described in this Statement of Work is for Supplier to provide Authorized User with IT-related services and deliverables. The Statement of Requirements (SOR), Appendix 1, is incorporated into this agreement. The SOW and SOR may contain additional terms and conditions; however, to the extent that the terms and conditions of the SOR are inconsistent with the terms and conditions of the Contract or any modification thereto, the terms of the Contract shall supersede. The Order of Precedence is:

I. Contract Including all modifications
II. The SOW
III. The SOR

1. Project Scope and Understanding of the Requirements

Supplier acknowledges it has reviewed the SOR and has completed Appendix 2, the Compliance Checklist, indicating any and all constraints and qualifications of this solution. The project scope, as defined by Authorized User, is contained in the SOR. This section describes Supplier's understanding of the scope and requirements.

Supplier understands the 2017 Virginia Base Map Program is a continuation of earlier similar programs seeking to acquire high resolution and high quality and accuracy 4 band orthoimagery, elevation data, and related products. For this specific task order Authorized User is seeking qualified and experienced geospatial quality assurance (QA) services to review data products produced by Fugro Geospatial, Inc. and confirm all project deliverables meet Authorized User project specifications and requirements. Primary data products to be reviewed include aerotriangulation (AT) and Ground Control (GC) reports, orthoimagery, Digital Elevation Models (DEM), Digital Surface Models (DSM). Other associated data products will be included in the review include trajectory files, seamline files, and metadata.

In the sections below Supplier outlines QA workflows, methodologies, and procedures being proposed to ensure Authorized User's aesthetic and functional data needs and project goals are achieved. Supplier will also present how the plan will adhere to project schedule, provide acceptable frequency and transparency of communication, assess spatial quality, and verify the accuracy requirements as well as other various required specifications. Strict and complete adherence to the required specifications and goals will ultimately bring Authorized User's Virginia Base Map Program 2017 to a successful conclusion.

Supplier's approach is based upon the depth and breadth of experience, education, and background of 13 Geospatial Data Services Team professionals. The combined subject matter expertise is used to design highly effective geospatial QA service for digital orthoimagery, DSM, and DEM data. Leveraging a combined 30 years of lessons learned as data acquisition, production vendors, and geospatial QA professionals has translated into a sophisticated geospatial quality assurance workflow. The proposed methods have been repeatedly and successfully applied to numerous federal, state, county, and local QA programs.

Supplier believes our strong industry backgrounds, experience, and detailed quality assurance processes uniquely positions us to provide the optimal quality assurance solution. Based on the requirements presented in the RFP Supplier has designed a QA methodology that will provide Authorized User with a comprehensive,

yet cost and time efficient quality review. Even with the large volume of data and stated schedule constraints, this approach does not exclude data, but offers a solid, detailed methodology built on hands-on experience ensuring Authorized User will receive the high quality geospatial data they contracted.

Project Extent and Anticipated Delivery Structure

Supplier understands the project area is comprised of the eastern third of the state. The 2017 eastern area acquisition is comprised of 12,268 1' digital orthoimagery delivered in 5000 x 5000 ft tiles covering approximately 57 individual/client jurisdictions with the potential for these jurisdictions to upgrade to either 0.5' or 0.25' as collection approaches.

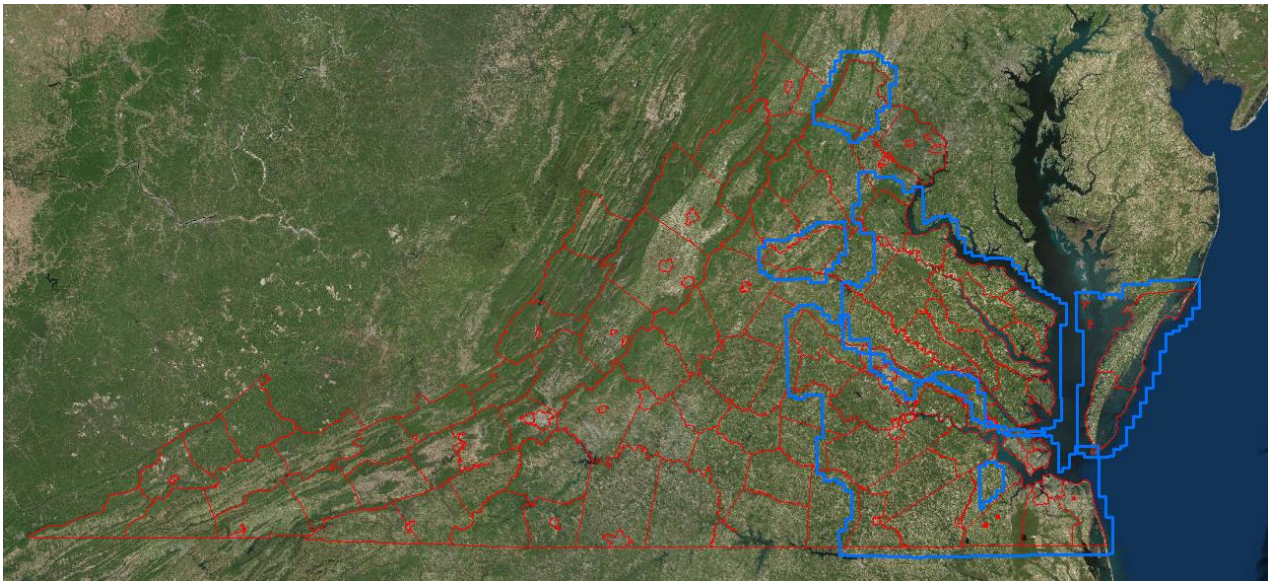


Figure 1: Five anticipated 1.0 foot orthoimagery areas covering 14,713 5,000' x 5,000' tiles

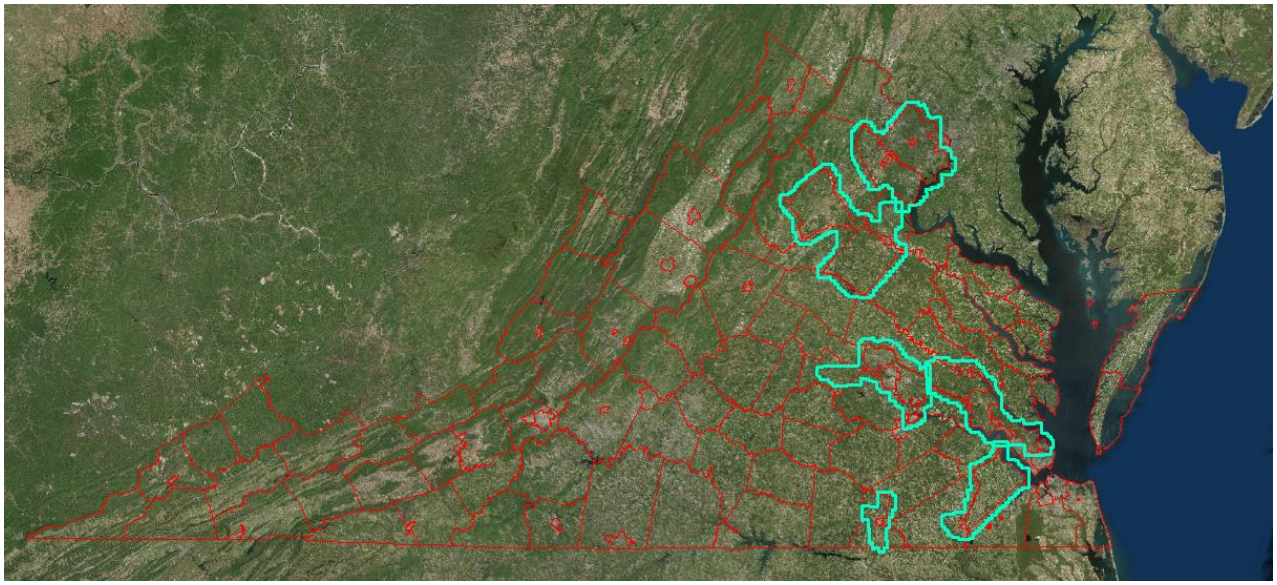


Figure 2: Six anticipated 0.5 foot orthoimagery areas covering 1,610 2,500' x 2,500' tiles

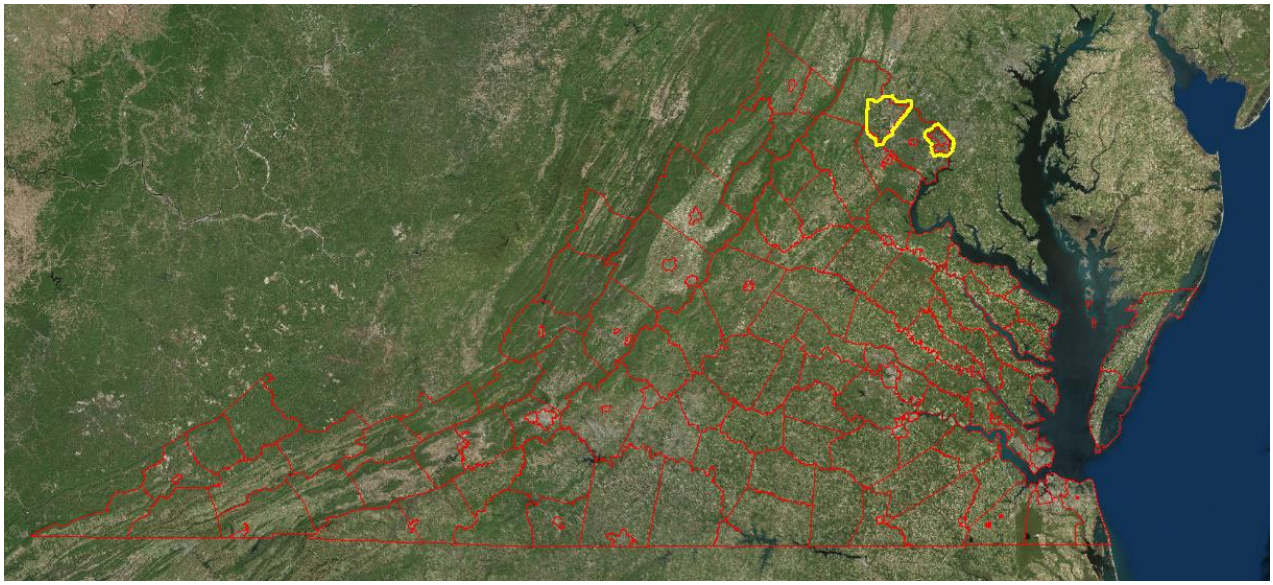


Figure 3: Two anticipated 0.25 foot orthoimagery areas covering 4,251 1,250' x 1,250' tiles

TABLE 1: ANTICIPATED DATA DELIVERY STRUCTURE			
Delivery Date	**Pixel Resolution**	**# of Delivery Data Blocks**	**QA Scale**
August 31, 2017	1.0'	5	1"=200'
November 30, 2017	0.5'	6	1"=100'
October 31, 2017	0.25'	2	1"=100'

2. Contract Products and Services to Support the Requirements

a. Solution Components

To perform this projects scope of work the Supplier will utilize existing investments in hardware and software that includes a dedicated server with 48TB of storage space, an ESRI ELA supporting GIS software needs (i.e. ArcMap, ArcCatalog, Spatial Analyst, 3D Analyst, Data Reviewer, etc.), LP360, and MicroStation as a means with which to assess data adherence to project requirements.

b. Services

Geospatial Data Quality Assurance Methodology Overview

Supplier's basic QA approach is formulated based on the following information and criteria:

- Authorized User's QA RFP documents:
  - The following specification and expectation documents have influenced development of the QA methodology:
    - *ASPRS Positional Accuracy Standards Edition 1 Version 1.0 November 2014.pdf* (Sections 7.3, 7.7, 7.8 and Annex B B.2)
    - *Exhibit G – Acceptance Criteria REVISED for VBMP 2017 Orthophotography Project Acceptance Criteria for Associated Services and Products.doc*

        - STATEMENT OF REQUIREMENTS (SOR) SOR # VITA-170127-01-CAI Independent Quality Assurance/Quality Control (QA/QC) For Virginia Base Map Program 2017
    - Project deliverables, formats, and schedule requirements
    - Use of existing and available checkpoints data provided by Authorized User coupled with the possibility of acquiring new/additional check points to satisfy project requirements
    - Thirteen (13) separate delivery blocks of data to be reviewed and delivered across 3 delivery dates
    - Requisite Authorized User specified data checks
    - Quality assurance geospatial deliverables must be delivered in ArcGIS 10.3.1 format and greater
    - Twelve month maximum period of performance
- Supplier's direct and extensive experience as:
    - Geospatial data acquisition vendors
    - Geospatial data processing vendors
    - Procurers of offshore geospatial production resources
    - Independent geospatial data validation service professionals

Proposed QA Methodology

The Supplier's history of providing geospatial quality assurance services since 2006 coupled with key resources prior experience working for premier national and regional mapping firms, we firmly believe Authorized User's is utilize the correct approach to ensure they receive the geospatial data they contractual expect from their mapping vendor.

Less aggressive QA reviews perform a sampling approach, which creates a level of risk where a defective product becoming characterized as an accepted product. Defective products can ultimately lead to erroneous decision making by end users resulting in negative and costly outcomes.

Performing a 100% Macro review of every data file within the project followed by a 100% detailed Micro review methodology assures all the data products have been tested to meet project expectations and requirements.

The proposed QA methodology presented in Table 2 is based on the following guiding influences:

- Our collective experience as independent QA consultants as well as extensive past experience as managing geospatial data acquisition and processing, and offshore geospatial vendors
- Presumed Authorized User project specifications and expectations as they relate to cost and schedule
- The sheer volume, variety, and complexity of deliverables and derivative products
- Assumption that the vast majority of the production will be performed by an offshore subcontractor

TABLE 2: QUALITY ASSURANCE METHODOLOGY SUMMARY

Data Product	Macro Review	Micro Review
Aerotriangulation Report Review	**100%**	**100%**
Ground Control Report Review	**100%**	**100%**
Digital Surface Model (DSM) Review	**100%**	**100%**
Digital Elevation Model (DEM) Review	**100%**	**100%**
Geotiff Orthoimagery Accuracy Assessment	**100%**	**100%**
Geotiff Orthoimagery Anomaly & Completeness Review	**100%**	**100%**
MrSID Orthoimagery Anomaly & Completeness Review	**100%**	**10%**
Final Deliverable Packaging Media (Jurisdiction and Statewide) Review	**100%**	**100%**
Independent Accuracy Assessment for Localities.(as requested)	**100%**	**100%**

Supplier's Macro and Micro Review Quality Assurance Process

Supplier's QA workflow is based upon the concept of Macro and Micro level data reviews applied to each data type to assess conformance to Authorized User specifications.

Supplier's Macro and Micro review framework will be tailored to Authorized User's assessment criteria as presented in the SOW/SOR's scope sections, or as negotiated. Supplier will execute Macro and Micro reviews using experienced and qualified geospatial QA professionals overseen by ASPRS certified professionals within our Germantown, Maryland office.

Supplier's QA process is based on a structured, sequentially gated process supported by Macro and Micro QA Task Tracking Checklists.

The QA review process contains two rounds. The Initial Review round assesses each delivery block in detail per the Macro and Micro checks detailed ahead. Supplier will review each delivery block or report and formally return findings to Authorized User and Fugro. Fugro will address edit calls (suspected specification deviation locations) and observations (comments made that are worth noting but may not be a specification deviation) made. The presumption to be made is Fugro will apply the QA findings to the entire delivery block or report and not just the calls provided prior to resubmittal.

The revised/corrected deliverable will be returned to Supplier where a Macro review will again be performed and a review each of the edit calls and observation remarks in the Validation Review. The purpose of the Validation Review round is to confirm each Initial Review call has been successfully addressed by Fugro. The expectation is no issues will be detected as part of the Validation macro review and no new issues have been introduced by Fugro as part of their corrective action efforts.

Details regarding the various checks and processes inherent in the Macro and Micro reviews follow below.

The benefits of this review structure are meaningful.

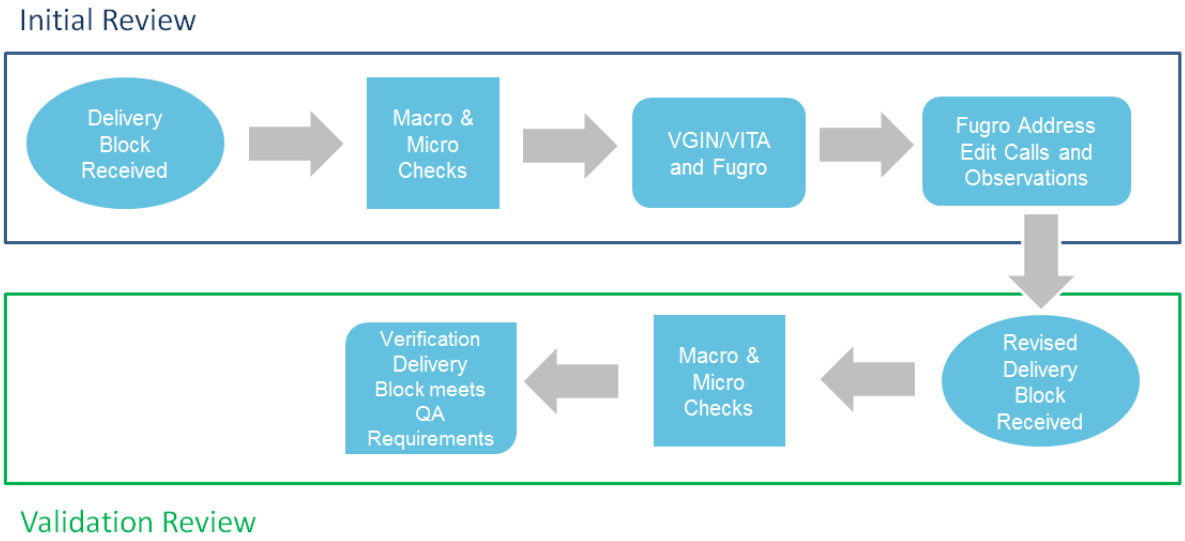


Figure 4. QA Workflow Summary

Macro Reviews

Macro reviews detect systematic issues immediately at the delivery block level, permitting rapid feedback to Authorized User and Fugro shortly after receipt of the data, often the same day. Quickly identifying systematic issues early allow Fugro to implement necessary corrective actions in yet undelivered production blocks, thus eliminating similar issues to be incorporated into future deliveries. Detecting systematic issues at the

beginning of the process speeds up Fugro's correction times and mitigates against pre-mature micro review efforts, representing additional time lost.

Macro reviews are primarily automated or semi-automated scripts and activities, designed to be accomplished on very large datasets in a fraction of the time of micro reviews. Macro reviews are designed to evaluate data on a high level, searching for systematic scope deviations in all project tiles.

Supplier's QA review policy is Macro QA edit calls need to be successfully addressed by Fugro prior to entering the Micro QA phase.

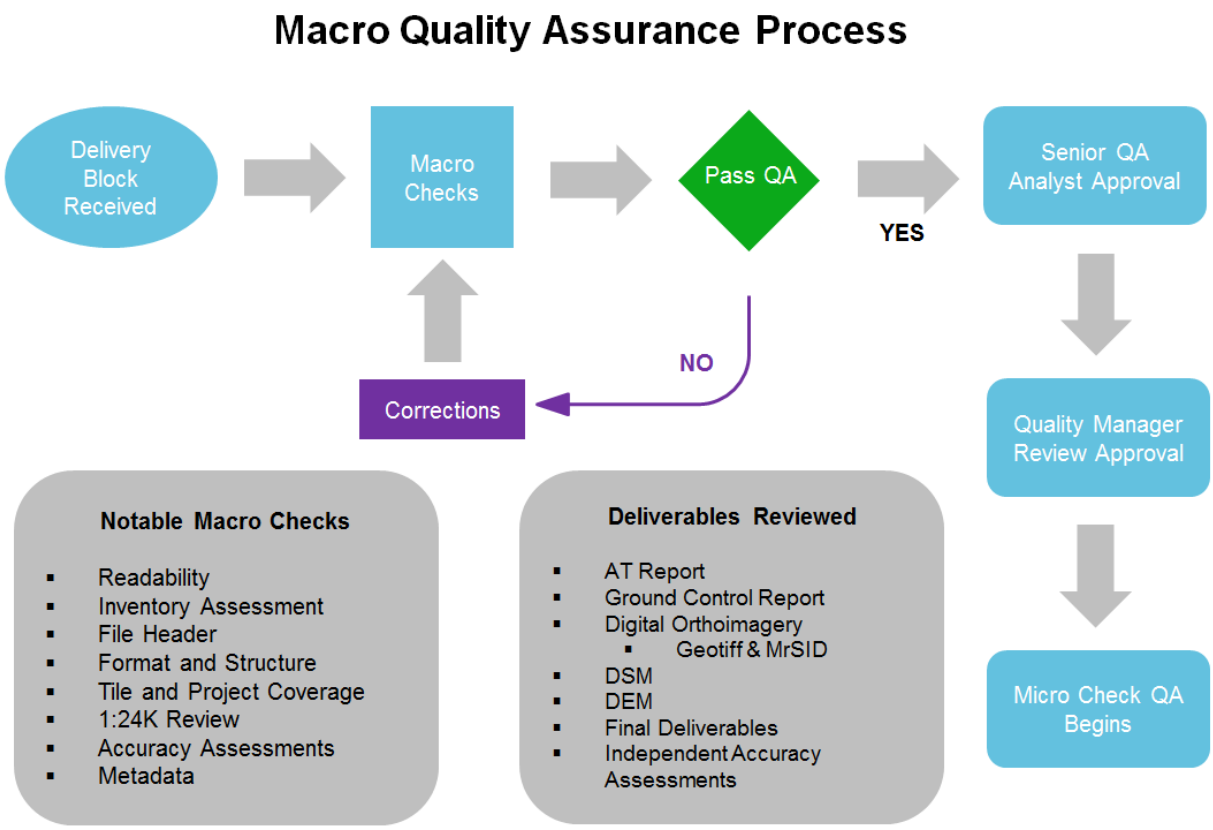


Figure 5 Supplier's Macro Review Quality Assurance Process

Micro Reviews

The bulk of the QA work is devoted to the Micro review effort. Micro level reviews are more detailed in nature and conducted at the tile level. The bulk of the Micro reviews require manual/visual inspection of the data by experienced QA analysts. As part of the Micro review process, for every file evaluated anomalies and deviations are spatially recorded and reported. Additional information and descriptions associated with the Micro review processes area detailed ahead.

Results from the Macro and Micro reviews, which include precise locations of anomalies detected, will be stored in an ArcGIS Shapefile (SHP) and provided to Authorized User and Fugro. Spatially referenced calls allow Authorized User and Fugro to quickly navigate to, and address, flagged anomalies. The SHP will also be used to develop maps that will be incorporated in status reports.

The table below summarizes the required Authorized User checks that will be performed, the type of check, and when the check will be performed. Following this table will be detailed descriptions of the Macro and Micro reviews applied to the deliverables that will ensure the data products meet project requirements.

TABLE 3: REQUIRED DATA CHECKS	Review Level	
	Macro	Micro
Aerotriangulation		
Review ground control locations within the block		X
Review ABGPS data (trajectory files)		X
RMSE of GPS residuals generally ≤ 10 cm		X
Analyze sidelap		X
Display all tie points (TP) and pass points (PP) and check for voids or irregularities	X	X
Precision of Image Observations - Sigma (0) ≤ 5μ is acceptable		X
Review written report for completeness, accuracy, correctness		X
Review submitted data for completeness, readability and format		X
Review Horizontal and Vertical RMSE of control points, tie points and pass points		X
Max. offsets [E, N] to any one blind QA point 3 * RMSE for that scale		
Check Metadata	X	X
Ground Control		
Review Ground control locations used in (AT)	X	X
A minimum of 2 base stations will operating during collection – all data will be submitted for OPUS processing with final results overall RMS <3cm		X
Review NGS locations used as tie or base station		X
Review distance to HARN/NGS points		X
Review horizontal and vertical accuracy		X
Offsets [E, N] to any one blind QA point ≤ 2 * standard deviation		X
Readability of Control Report		X
Review location sketch/image/description		X
Review GPS data for PDOP (Position Dilution of Precision)		X
Review GPS data for VDOP (Vertical Dilution of Precision)		X
Review time of GPS observations		X
Check Metadata	X	X
Digital Elevation Model		
Files are readable from source	X	
Check for georeferencing (name vs. grid location)	X	
Check for 3D coordinates (points and 3D lines)	X	
Check for high/low points (spikes)		X
Check for voids (gaps)		X
Check for spacing		X
Check to make sure all requested tiles are delivered	X	
Check Metadata	X	X
Check files are readable in current version of ArcGIS (10.3.1 and greater)	X	

Digital Orthophotography (1', 6", and 3" GSD) on a tile by tile basis		
Media is readable	**X**	
Correct file format (4 Band – R,G,B,IR)	**X**	
Conformance of sheet to index grid - Tiles are georeferenced and appear in the correct location (tiff and MrSid)	**X**	
Check GeoTIFF 6.0 header against tfw (tiff world file)	**X**	
Correctly defined projection information (tiff and MrSid) using NAD_1983_HARN_StatePlane_Virginia_North_FIPS_4501_Feet and NAD_1983_HARN_StatePlane_Virginia_South_FIPS_4502_Feet	**X**	
Check pixel size	**X**	
Pixel definition - GeoTiff reference will be the upper left corner of the upper left-most pixel. World file reference will be the center of the pixel of the upper left-most pixel	**X**	
Georeferencing precision – two significant digits	**X**	
Horizontal Accuracy per ASPRS and NSSDA specifications for each scale	**X**	
Review color/contrast against approved image chips	**X**	
Review imagery at 1:24,000 scale to identify significant tonal variations and/or data voids.	**X**	
Tonal Quality - Less than 2% of values at 0 or 255		
Check large areas for color balancing issues	**X**	
Check color balancing between blocks of different resolution as defined by pilot projects	**X**	
Check for image blemish and artifacts		**X**
If 1 pixel wide, 100 pixels in length.		
If 2 pixels wide, 60 pixels in length.		
If 3 pixels wide, 20 pixels in length.		
If 4-12 pixels wide, 12 pixels in length.		
Review mosaic lines - buildings and bridges, roads		**X**
Check for smears		**X**
Check for wavy features (roads and building roofs)		**X**
Check to make sure all requested tiles are delivered	**X**	
No seamlines through buildings and above ground transportation structures shall be avoided to the greatest extent practical.		**X**
Check for mismatch along seam lines and AT block seams (including blocks having different resolution)		**X**
Check Metadata	**X**	**X**
Digital Surface Model - is not intended to be a final product		
Media is readable and uniform	**X**	
Correct file format	**X**	
Data is complete and no tiles missing	**X**	**X**
Check files are readable in current version of ArcGIS (10.3.1 and greater)	**X**	
Final Deliverable Packaging Media (Jurisdiction and Statewide) Review:		
Media meets design specifications	**X**	
Media is readable - correct file formats	**X**	
All Files are Readable in current version of ArcGIS	**X**	
Media is complete-all appropriate information is provided	**X**	
Independent accuracy assessment for localities.		
Upon Request by VGIN or Locality only	**X**	**X**
Requestor will provide additional control at no cost to vendor	**-**	**-**

Check accuracy against blind check points and ground control points when control points are provided by localities		X
Prepare NSSDA report sheet		X

Macro and Micro Review Process for Aerotriangulation and Ground Control Reports

Supplier proposes to critically review Fugro's aerotriangulation (AT) and Ground Control (GC) reports. The results of these critical reports provide significant insight, as they are the first look as to how well the data aligns with itself and Fugro's ground control.

AT Report

Supplier will review the AT Report for compliance for the following components:

- Distribution and quantity of ground control points across the AT block as well as the ground control relationship with the flightlines (via trajectory files) and areas of overlap
- Review ABGPS trajectory file to assess forward and side overlap
- Distribution and density of tie points and pass points. Investigate areas of low point density. Confirm precision of image observations sigma is ≤ 5µ
- Individual horizontal and vertical RMSE results derived from tie points, pass points, and ground control points.
- Overall readability and completeness
- Review metadata for alignment with Fugro's declared production processes, completeness, and validate metadata structure for compliance using USGS Metadata Parser
- Note, per response to Supplier questions the checks below are not required:
  - Review horizontal and vertical RMSE on blind points (collected by QAQC vendor or provided by the Commonwealth) and prepare NSSDA accuracy sheet. Ensure maximum Easting and Northing offsets to any one blind QA point does not exceed 3*RMSE for the appropriate scale

Ground Control Report

Supplier will review the Ground Control Report for compliance for the following components:

- Distribution and quantity of ground control points across the AT block as well as the ground control relationship with the flightlines (via trajectory files) and areas of overlap
- Distribution and distance of NGS/HARN/CORS locations as basestation references. Ensure minimum of 2 base stations will operating during collection and all data was submitted for OPUS processing with final results overall RMS <3cm.
- ABGPS data for GPS Time, PDOP, and VDOP threshold violations during data acquisition
- Assess reported horizontal and vertical accuracy results
- Review ground control location sketches and images
- Review overall readability and completeness
- Review metadata for alignment with Fugro's declared production processes, completeness, and validate metadata structure for compliance using USGS Metadata Parser

Establish a Geodetic Control Network for Check Points (if necessary)

It is understood that Authorized User may have adequate historical checkpoint data location suitable to be used to independently assess the accuracy of the project datasets and reports.

However, should it become necessary to collect additional ground control Supplier can leverage existing longstanding relationships to secure the necessary capabilities to achieve the necessary accuracies and schedule timeline if needed. Costs to perform these services are not included in this proposal.

Macro Review Process for Orthoimagery, DSM, and DEM Data

Inventory Assessment

Completeness Review - The QA analyst will manually review the content of the delivered drive against the appropriate tile layout for the expected delivery block. The number of expected tiles along with the expected format of the tiles (i.e., orthoimage, DSM, DEM, etc.) will be checked.

Inventory and Software Readability Reviews - The QA analyst will review file sizes to determine if any should be flagged as possibly being corrupt. For instance, an orthophotography tile with a file size significantly different than the majority of files would be flagged as it is likely corrupt. Any flagged files will be further investigated to determine the source of the issue.

In addition, the QA analyst will open all data files on the data drive using the appropriate software to ensure that the files are readable and that no corrupt files are present on the drive.

File Header Check

The File Header Check is an automated scripting process, which extracts and examines the image header information from the orthoimage, DSM, DEM, GDB, etc files. File header information will then be reviewed per the checks outlined in the table below:

TABLE 4: FILE HEADER CHECKS

File Header Check	Specification	Geotiff Ortho Check	MrSID Ortho Check	DEM Check	DSM Check
Horizontal Datum	North American Datum of 1983/93 HARN	Y	Y	Y	Y
Vertical Datum	Vertical datum for orthometric heights will be the North American Vertical Datum of 1988 (NAVD 88).	Y	Y	Y	Y
Geoid Model	To be determined	Y	Y	Y	Y
Coordinate Reference System	Virginia State Plane (North or South Zones)	Y	Y	Y	Y
Coordinate Reference System presented in WKT format	Utilization of Open Geospatial Consortium (OGC) Well Known Text (WKT)	Y	Y	Y	Y
Units of Reference	US Survey Feet	Y	Y	Y	Y
Correct File Format	GeoTIFF/DSM/DEM/ as applicable	Y	Y	Y	Y
Raster Pixel Resolution	3”, 6”, 12” Ortho,	Y	Y	-	Y
Tile Extents	X & Y Minimum and Maximum do not exceed tile X & Y minimum and maximum	Y	Y	Y	Y

Upon completion of the File Header Checks, results are reviewed by the Senior QA analyst for any anomalous values within any of the fields. This process is expedited through the use of conditional formatting in a spreadsheet to highlight any potential issues.

File Format and Structure Checks

Format and structure checks verify the files have been delivered in the correct format. It is expected that the following formats will be received for this project:

- Uncompressed 4 band orthoimage tiles – TIFF/TFW format
- Compressed 4 band orthoimage tiles – SID/SDW format
- Digital Surface Model (DSM) – format to be determined
- Digital Elevation Model (DEM) – MicroStation V8 .DGN format
- Flight Line trajectories – ESRI point .SHP format
- Orthomosaic Seamlines – ESRI Polygon .SHP or Feature Class format
- FGDC compliant metadata – .XML format

Project and Tile Coverage
The Project coverage check ensures Fugro has adequately planned to fly and capture the entirety of the project area of interest.

At first glance, tile indices may seem to be created correctly; however, there have been many projects that required complete redelivery of data due to minute errors introduced by an incorrectly prepared project tile index. The tile coverage check ensures the tile index was created to support the project datum and projection, fully covers the project area of interest, tile edges match without overlap, slivers, or data gaps; pre-requisites to create seamless derivative products, and the tile dimensions is an integer multiple of the cell size for raster deliverables.

As part of these checks the QA analyst will visually ensure that the orthoimagery, DSM, DEM data covers the expected project tile index, the data appears seamless across tile boundaries, and extends to the required project boundaries. Additionally, gaps or voids between and overlapping tiles are detected, thereby verifying alignment of data to the project tile structure.

The Project and Tile Coverage Macro check compliments the File Header Check in that any file with missing or incorrect georeferencing information would generate a tile extent polygon in an incorrect location.

1:24,000 Scale Macro Review
Supplier will review each 1" resolution image block at the 1:24,000 scale with the intent of detecting significant radiometric variations as well as identifying data voids. Supplier will review 0.5' and 0.25' resolution image blocks similarly at 1:12,000 and 1:6,000 scale respectively.

Accuracy Assessment
To assess orthophotography horizontal positional accuracy Supplier will rely upon the existing and available Authorized User provided checkpoints and will be guided by ASPRS standards per the SOR/SOW requirements. It is will assumed the checkpoints will be identifiable in the 2017 imagery and be at least 3x more accurate than the dataset to be tested.

ASPRS guidelines suggest a minimum of 20 well distributed and well defined bare earth control points across the area to be tested. Supplier assumes Authorized User will provide at least 20, and not more than 40, checkpoints for each of the four data delivery blocks. Supplier will assess the accuracy of the deliverables that intersect the available control points. ASPRS accuracy calculations confirming project accuracy will be performed and included in the data block delivery report.

Performing Accuracy Assessments
Supplier will utilize ESRI ArcGIS and QCoherent's LP360 to perform the accuracy assessment of the orthoimagery and DEM data. Using these tools, the alignment between the imagery and elevation datasets and each QA control point can be easily assessed, documented, and a detailed accuracy assessment report generated. The tested accuracies will be compared and reported against the requirements. A report detailing the results and deviations for each checkpoint, along with the overall results, will be provided at the completion of this QA phase.

Results will be reviewed and approved by the Supplier ASPRS Certified Photogrammetrist prior to submittal to Authorized User Project Manager.

Metadata Review
The Supplier metadata review process will incorporate reviews for all relevant project metadata. The .XML metadata files will initially be checked to confirm a 1 to 1 correspondence with corresponding data files, proper naming convention, and readable by ESRI's ArcGIS v10.3.1 and greater software. Supplier will review the metadata text for adequate and appropriate textual content. Content commentary will be included in the delivery area report. Metadata XML files will also be evaluated using the USGS metadata validation service (http://mrdata.usgs.gov/validation) to check for proper Federal Geospatial Data Committee (FGDC) structure and elements.

Metadata will be checked for each deliverable product group

- Aerotriangulation
- Ground Control
- Orthoimagery

- DEM

Micro Review Process for Orthoimagery, DSM, and DEM Data

Although a great number of checks to test data conformance are performed as part of the Macro review process, more detailed tests are required before the complete quality and adherence to the required specifications of the various datasets can be fully understood.

Micro review processes record anomalies as outlined in Authorized User's scope of work. During the Micro review, the QA Analyst will review each of the deliverable datasets at the appropriate scale to assess for, and spatially record, scope deviations as necessary.

Micro reviews represent the bulk of the effort associated with an orthophotography, DSM, and DEM QA review project. Micro reviews involve the detailed, manual, methodical visual review of the data by an experienced Supplier QA Analyst using ArcGIS, MicroStation, and LP360. QA analysts are searching for specific non-desirable aesthetic conditions, specification deviations, as well as other anomalies that may interfere, obscure, or falsify subsequent geospatial exploitation and analysis by Authorized User.

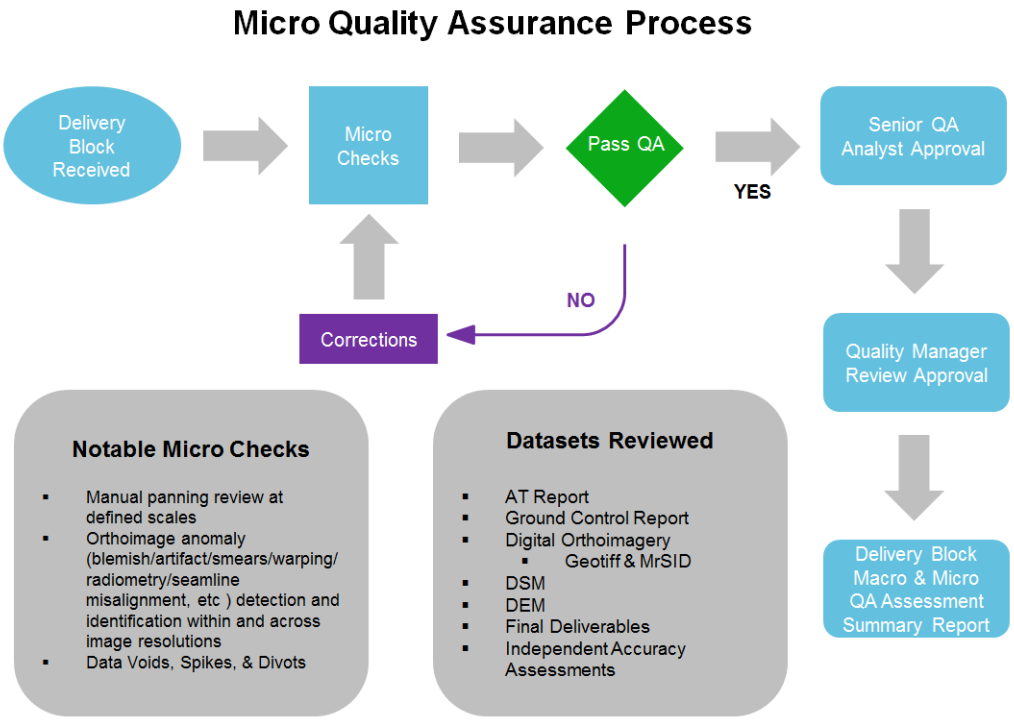


Figure 6. Supplier's Micro Review Quality Assurance Process

Orthoimagery Micro Checks

Authorized User's, as well as many industry standard aesthetic and functional requirements as they relate to RGB + CIR orthoimagery quality assessments, will be incorporated into the orthoimagery micro checks, listed below. Orthoimagery will be reviewed at the following scales:

TABLE 5 : ORTHOIMAGE RESOLUTION AND REVIEW SCALE	
Orthoimage Pixel Resolution	**Review Scale**
1.0 Foot	1:24,000
0.5 Foot	1:12,000
0.25 Foot	1:6,000

Supplier will identify the following anomalies at the scale noted above:

- Warped bridges, overpasses, viaducts, roads, buildings, railroads, and the like
- Misalignments in linear features (roads/curbs/building edges etc.) resulting from poorly stitched mosaics or image alignment or processing issues
- Obvious seams between images
- Ensure seamless color continuity – Identify undesirable changes in color balance and contrast within and across delivery block boundaries
- Anomalous/generic artifacts resulting from imagery collection
- Blemishes, blotches, or areas of under/over exposure (histogram bias) introduced during image capture or in the subsequent processing of the imagery
- Any obscurities including but not limited to clouds, flooding, snow cover, tree leaves, fog, haze or smoke
- Stark shadows or bright spots in the imagery that negatively limit the interpretive value of the imagery
- Flag locations where tall buildings obscure adjacent roadways/transportation features

Supplier will apply the above checks to the RGB imagery initially at a scale that is appropriate to the pixel resolution after which the CIR band combinations will be reviewed at a smaller scale.

Supplier will perform a 100% Macro review of the MrSID version of the Geotiff imagery. Because the MrSID imagery is a compressed copy of the geotiff imagery Supplier proposes performing a randomized 10% Micro review of the MrSID imagery.

Digital Elevation Model QA Review Checks

Supplier will convert the provided mass point and breakline MicroStation V8 DEM DGN files into an ArcGIS raster. Where breaklines exist they will be used to enforce the complexion of the terrain surface. Applying semi-automated and manual processes Supplier will manually review the Terrain for data voids, gaps, and spikes. A density raster will also be created to highlight areas of low data density requiring further attention.

The QA analyst uses several automated and manual checks to verify the quality of the DEM, presented below:

Data Void/Gap Check

- The QA analyst constructs a raster from the DEM tiles that detects Null values and are exported to a SHP for rapid analysis. Since Null areas are isolated, they are easily reviewed and provided to Fugro as needed.

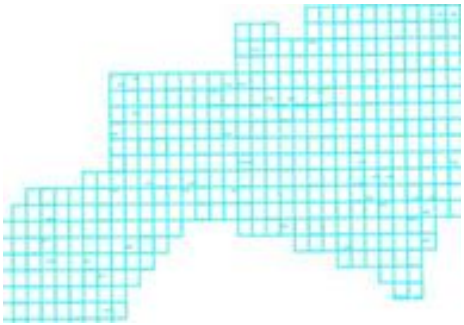


Figure 7. Void SHP Shows DEM Issues

Spikes/Divots

- Data spikes and divots are detected by constructing slope rasters from the DEM data. Areas having unnaturally steep slopes are isolated, merged, and output as a SHP for further analysis. The QA analyst reviews all areas isolated to ensure that it's a naturally occurring ridge, trough, or pit. Unexplained spikes or divots (invalid or unnatural minimum and maximum elevations) are flagged as edit calls and provided to Fugro for review and correction or comment.

Manual Review

- The QA/QC analyst imports the DEM files into ArcGIS for a manual review of the DEM tiles. Using hill and slope shading during the review enables easier identification of anomolous data. The QA analyst will also ensure that no non-ground features have been incorporated into the DEM.

Final Deliverable Packaging Media (Jurisdiction and Statewide) Review

Supplier will review each of the deliverable media drive and confirm it meets the design specifications, all required files are provided and file formats are correct, and the data contents can be viewed in ArcGIS 10.3.1 or greater.

Independent Accuracy Assessment for Localities Review

Upon request from Authorized User or a local authority Supplier will perform additional accuracy checks on up to two localities using provided checkpoint data that meets the project requirements. Supplier will also prepare an NSSDA accuracy report.

QA Process Summary Reports

Upon completion of the Macro and Micro review of each delivery area, Supplier will formally provide the results of the Macro and Micro review findings for each of the datasets reviewed. A formal report will include the following:

- Performing geospatial QA can be a complex process requiring tracking the status of multitude of deliverables and tasks comprising thousands of tiles and hundreds of process steps. To maintain order and efficiency Supplier has developed a geospatial QA database and QA checklists designed to track and document the status of each deliverable against the project's scope specifications. Checklists are an integral tool used to support daily progress assessments and expedite status reporting. Checklists used during QA will be included in the report.
- Authorized User provided tile indices will be used to track production and include attribution indicating tile acceptance, rejection, and reason for rejection status.
- An ArcGIS v10.3.1 and greater GDB containing the location of data anomalies including contextual Supplier guidance comments, as necessary, to permit Authorized User and Fugro immediate access to issue locations for rapid review, comment, and/or correction. The GDB also serves as a means with which to transparently document and convey additional comments by Authorized User and Fugro.

A detailed report documenting all Macro and Micro QA findings will be provided. Quality tests that passed will be indicated as well as tests that did not pass the required specifications. Additional clarifying commentary or questions in the form of observations will be included for those tests that did not pass or exhibited unexpected findings. Please see the table below for additional rquired reporting elements that will be deliverred to Authorized User.

TABLE 6: REQUIRED QA REPORT COMPONENTS SUMMARY

QA Check	Deliverable Description
Aerotriangulation	Documentation for each AT block will be provided. Report will include if the AT block meets project specifications or has been rejected. Reason for rejection will be included in the report. A final AT block report will document final acceptance of the AT Block.
Ground Control	Documentation on the statewide adjustment and for each network will be provided. Report will include if the Ground Control meets project specifications or has been rejected. Reason for rejection will be included in the report. A final report for the statewide adjustment and each network will document final acceptance.
Digital Elevation Model	Shapefiles that document findings for each DEM tile. Attribution will be included in the tile index indicating if the tile meets specification or does not meet specification, including the reason why the tile does not meet specification. A report will document final acceptance of all tiles within each delivery group/area.
Digital Orthophotography	Shapefiles that document findings for each orthoimage tile. Attribution will be included in the tile index indicating if the tile meets specification or does not meet specification, including the reason why the tile does not meet specification. A report will document final acceptance of all tiles within

	each delivery group/area. The report will also document the horizontal accuracy using independent check points.
Digital Surface Model	A report will document final acceptance of the Digital Surface Model indicating the DSM is complete, readable and uniform with no tiles missing.
Final Deliverable Packaging Media (Jurisdiction and Statewide) Review	Documentation identifying any failures by package/media and final document. Supplier certifies final acceptance of each deliverable package/media.
Independent Accuracy Assessment for Localities	Ortho Summary Statistics and Ortho Horizontal Accuracy Results per NSSDA.

Supplier will provide geospatial quality assurance services as described in the proposal body.

c. Training and Knowledge Transfer

No training or knowledge transfer services are proposed.

d. Support

Supplier's proposal assumes Authorized User will provide clarification as needed as the project evolves, as well as, provide the documents and data layers described in the SOR/SOW necessary to execute the QA processes.

3. Project Events and Tasks

Project Kickoff
- Discuss project scope, schedule, budget
- Capture any relevant action items

Review One Foot Project Deliverables
- Review block AT reports
- Macro/Micro checks of imagery against scope acceptance requirements
- Review digital surface model
- Capture edit calls from reviewed data and provide to mapping vendor
- Prepare block quality reports

Review Six Inch Project Deliverables
- Review block AT reports
- Macro/Micro checks of imagery against scope acceptance requirements
- Review digital surface model
- Capture edit calls from reviewed data and provide to mapping vendor
- Prepare block quality reports

Review Three Inch Project Deliverables
- Review block AT reports
- Macro/Micro checks of imagery against scope acceptance requirements
- Review digital surface model
- Capture edit calls from reviewed data and provide to mapping vendor
- Prepare block quality reports

Review Final Deliverable Package
- Review the provided final deliverable data files and identify any deviations from project requirements as they relate to package/media and final document. Supplier will certify final acceptance of each deliverable package/media.

Final Reporting
- Supplier will summarize reporting conducted for each project deliverable type certifying final acceptance of each deliverable.

4. Period of Performance

Implementation of the solution will occur within 12 months of execution of this SOW. This includes delivery and installation of all products and services necessary to implement Authorized User's solution and any support, other than on-going maintenance services.

5. Place of Performance

Tasks associated with this engagement will be performed at the Supplier's office located in Germantown, MD.

6. Supplier Personnel

Supplier and Authorized User agree that qualified and experienced personnel indicated as "Key Personnel" are critical to the performance of the project and that they will not be removed from this task without prior approval from Authorized User and that Authorized User will have the right of refusal for any personnel assigned to the Team. After task award, Supplier shall secure written approval from Authorized User prior to making any changes in Team personnel. Supplier will notify Authorized User, in writing, of any changes in the personnel assigned to the Team. The qualifications of new personnel should be equal to or exceed those of the replaced personnel. After task award, Authorized User may request replacement of Team personnel. Such requests will be in writing.

Qualifications and References for Subcontractor personnel are contained in Appendix 3, Subcontractor Personnel Qualifications and References.

The roles listed in the table below represent the minimum Supplier personnel requirements for this engagement.

TABLE 7: SUPPLIER PERSONNEL

Deliverable, Milestone, or Task	Proposed Staff Resource	Project Role	Years of Experience	Certifications
Milestones 1 – 17	John Knowlton	Project Manager/Photogrammetrist	16	PMP #290756 GISP #62070 ASPRS CP #1564
Milestones 1 – 17	Bobby Riley	Quality Assurance Manager/Photogrammetrist	18	PMP #1720826 ASPRS CP #1570
Milestones 1 –17	Jesse Pinchot	Quality Assurance Analyst/Mapping Scientist	10	GISP #90257 ASPRS CMS #GS265

Key staff will be responsible for all project deliverables as well as the management of any analyst level staff supporting the imagery reviews.

Milestones, Deliverables, Payment Schedule, and Holdbacks

The following table identifies milestone events and deliverables, the associated schedule, associated payments, any holdback amounts, net payments, and interdependent deliverables.

The QA/QC Vendor will arrange workflows and schedules with the Authorized User and Fugro to complete QA/QC of orthophoto and DEM tiles of the same percentages no later than 30 days after the corresponding delivery from Fugro.

The minimum required milestones and deliverables and the estimated completion date for each deliverable are listed in the following table.

TABLE 8: MILESTONES, DELIVERABLES, PAYMENT SCHEDULE, AND HOLDBACKS

#	Milestone Event	Deliverable	Schedule	Payment	Hold back	Net Payment	Interdependent Deliverable(s)
1	QA/QC of ortho and dem products (15%)	Imagery QA Report Results and Edit Calls	31-Jul-17	$11,875.00	N/A	$11,875.00	N/A
2	QA/QC of ortho and dem products (20%)	Imagery QA Report Results and Edit Calls	31-Aug-17	$17,356.00	N/A	$17,356.00	N/A
3	QA/QC of ortho and dem products (15%)	Imagery QA Report Results and Edit Calls	30-Sep-17	$26,492.00	N/A	$26,492.00	N/A
4	QA/QC of ortho and dem products (15%)	Imagery QA Report Results and Edit Calls	31-Oct-17	$30,145.00	N/A	$30,145.00	N/A
5	All remaining products, reports, certifications, and accuracy assessments.	Final Deliverable Package Review/Final Report	31-Oct-17	$5,570.00	N/A	$5,570.00	Dependent on completion of items 1-4
	TOTAL			**$91,438**		**$91,438**	

GROUND SURVEY CHECKPOINTS - $300 PER POINT, 20 POINT MINIMUM

The total solution price shall not exceed $US 91,438.00.

In addition to the required deliverables specified in the SOR, Supplier will provide copies of any briefing materials, presentations, or other information developed to support this engagement.

Deliverable Acceptance Process
Each deliverable created under this Statement of Work will be delivered to Authorized User with a Deliverable Acceptance Receipt. This receipt will describe the deliverable and provide the Project Manager with space to indicate if the deliverable is accepted, rejected, or conditionally accepted. Conditionally Accepted deliverables will contain a list of deficiencies that need to be corrected in order for the deliverable to be accepted by the Project Manager. The Project Manager will have thirty (30) days from receipt of the deliverable to provide Supplier with the signed Acceptance Receipt.

8. Acceptance Criteria

Acceptance Criteria for this solution will be based on production block quality reporting as well as a Final Report deliverable.

9. Project Roles and Responsibilities

TABLE 9 : PROJECT ROLES AND RESPONSIBILITIES

Responsibility Matrix	Supplier	Authorized User
QA/QC Services	✓	
Required reports and certifications	✓	
Required accuracy assessments	✓	
Coordination of product deliveries from orthophotography vendor to QA/QC Supplier		✓
Review and acceptance of services, reports and certification		✓

10. Assumptions

This section contains assumptions specific to this engagement.

- All ortho, DEM, and DSM data files will be provided on a mobile hard drive.
- Repetitive, systematic, frequently reoccurring edit calls will be captured so as to provide a representative sample of the issues encountered. Therefore, not every instance of a systematic call will be captured.
- QA reviews on delivery blocks having significant quality issues will be returned to Fugro to rework. Supplier's review period will not be abbreviated in these instances.
- In order to meet the project schedule, data submittal for review delays will have a direct impact on the unit of time Supplier has allocated to review the data. Supplier's review period will not be abbreviated in these instances.
- Already defined delivery blocks will not be further sub-divided into interim, or "partial", deliverable areas.
- Unless negotiated otherwise, Supplier's proposal assumes there will be at least one, and not more than two, submittals for QA testing for each delivery area. Supplier assumes all products undergoing a second Micro review will pass the review. Supplier's estimated review timeframe assumes no more than two Micro reviews will be performed on any one tile for each deliverable product. The Validation Micro review will be confined to the Initial Micro review deviation calls. If previous Initial Macro and Micro deviation calls have been addressed Supplier will report the tile meeting the project quality requirements.
- Supplier cost estimate assumes two Independent accuracy assessments for specific localities will be performed.
- Supplier cost estimate assumes no travel will be required.
- Supplier cost estimate assumes a total of 12 hours of time will be allocated to background check processes.
- No Holdbacks are to be applied to invoicing.

11. Security

No additional security required. Supplier will comply with necessary background check requirements as provided by Authorized User.

12. Performance Bond.

No performance bond required.

13. Risk Management

As noted in the SOR document, the project's level of complexity is considered moderate and will be executed by experienced geospatial professionals using well established technologies and processes by Fugro, whom are known to produce high quality geospatial products on time.

The below table represents what the Supplier believes are the main potential risks for this project and how those risks are mitigated.

TABLE 10: RISK EVENTS & MITIGATION				
Risk	**Impact**	**Likelihood**	**Risk Mitigation Strategy**	**Overall Risk**

Data Server Crashes	3 -Significant	1 - Rare	The Supplier backs up the server data daily as well as runs redundant servers preventing catastrophic failures. Additionally, the Supplier will copy all Fugro provided imagery/surface data to a data server and retain the original data drives until work on those areas has been completed.	Low
Delays in receiving the data	2 - Minor	3 - Moderate	The Supplier can leverage additional resources as needed to increase its reviewer resources and work to maintain the schedule. The Supplier has over 50 ArcGIS users at its performance location that can be leveraged as needed to support this project. There is also an ELA with ESRI in place that allows the Supplier to quickly add resources from a non-traditional resource pool.	Medium
Receive more data than originally planned for a deliverable	1 - Insignificant	3 - Moderate	As mentioned above, the Supplier can leverage additional resources and software as needed to mitigate a deviation in the volume of data from the original plan.	Low
Extreme Weather Event	3 -Significant	2 - Unlikely	The Supplier has well over dedicated GIS professionals in offices across the United States. If an extreme weather event occurs resources can be leveraged at other offices in non-impacted areas to ensure there are no major delays.	Medium
Corrupt Hard Drive/Hard Drive Failure	1 - Insignificant	3 - Moderate	The Suppliers close proximity to the Authorized User and Fugro all it to quickly drive to either location to pick up new data drives as required. This close proximity can greatly save time if there is a deliverable hard drive issue.	Low

14. Reporting

The Supplier will be available for weekly conference calls and a weekly status report will be submitted by Supplier to Authorized User. Reports will include accomplishments to date as compared to the project plan; any changes in tasks, resources or schedule with new target dates, if necessary; all open issues or questions regarding the project; action plan for addressing open issues or questions and potential impacts on the project; risk management reporting.

Supplier understands orthophotography acquisition effort is managed by a team consisting of the Authorized User program manager, a vendor project manager and the Supplier project manager. The Supplier will have direct contact with the orthophotography vendor; however, the Authorized User program manager will be copied on all communications.

15. Point of Contact

For the duration of this project, the following project managers shall serve as the points of contact for day-to-day communication:

Authorized User: Wendy Stout

Supplier: Cynthia Sullivan, CAI Account Manager

By signing below, both parties agree to the terms of this SOW.

Supplier	**Authorized User**
Supplier Name: Computer Aid, Inc.	Agency: _____
By: _____ (Signature)	By: _____ (Signature)
Name: _____ (Print)	Name: _____ (Print)
Title: _____	Title: _____
Date: _____	Date: _____

Statement of Requirements (SOR)
SOW Appendix 1

STATEMENT OF REQUIREMENTS (SOR)

SOR # *VITA-170127-01*-CAI

Independent Quality Assurance/Quality Control (QA/QC)
For Virginia Base Map Program 2017

1. **Date:** February 28 2017

2. **Authorized User**: Virginia Geographic Information Network / Virginia Information Technologies Agency

3. **Authorized User Contact Information:**

Wendy Stout
VGIN Geospatial Program Manager
11751 Meadowville Lane
Chester, VA 23836
Phone: (804)416-5036
E-mail: wendy.stout@vita.virginia.gov
Fax: 804-416-6353

4. **Solicitation Schedule:**

Event	Date
Release SOR	February 28, 2017
Supplier Response Due	Mar 16, 2017
Award Decision	Mar 23, 2017
Estimated Project Start Date	Apr 1, 2017

5. **Evaluation and Scoring**

Criteria
Technical Proposal
Cost
SWaM Commitment

Supplier's Response must be submitted in the specified Statement of Work (SOW) format and will be evaluated for format compliance.

Supplier's Response will be evaluated for technical merit based on its appropriateness to the performance of agency requirements, its applicability to the Commonwealth Agency's environment, and its effective utilization of Supplier and Commonwealth resources.

6. Project/Service:
Quality Assurance/Quality Control (QA/QC) for Photogrammetric Products

7. Specialty Area (Check one)**:**

- ☐ Application Development
- ☐ Business Continuity Planning
- ☐ Business Intelligence
- ☐ Business Process Reengineering
- ☐ Enterprise Architecture
- ☐ Enterprise Content Management
- ☐ Back Office Solutions
- ☒ Geographical Information Systems
- ☐ Information Security
- ☐ IT Infrastructure
- ☐ IT Strategic Planning
- ☐ Project Management
- ☐ Public Safety Communications
- ☐ Radio Engineering Services
- ☐ IV&V Services

8. Contract Type (Check)**:**

☒ Fixed Price, Deliverable-based

9. Introduction:

Project History
The Virginia Base Mapping Program (VBMP) acquired statewide aerial photography in 2002 and again in 2006/2007 and 2009, 2011 and 2013, 2015. In 2017 the eastern third of the state will be flown. The orthophotography program was established to promote effective and economically efficient development and sharing of spatial resources across the Commonwealth. The Commonwealth of Virginia also sought to establish a consistent foundation or base map resource upon which local government spatial data, application and GIS could be consistently developed and maintained. Virginia is now committed to sustaining this program through regular updates of the photography.

Business Need
The Vendor will provide independent quality assurance/quality control (QA/QC) for digital color orthoimagery and digital elevation models provided by Fugro Geospatial, Inc. to the Virginia Geographic Information Network as part of the Virginia Base Map Program 2017 acquisition. The products subject to QA/QC will include all the areas of the state flown in 2017.
Project Complexity

The project is of moderate complexity. The orthophotography products are produced by Fugro Geospatial, Inc. with mature and established product workflows.. Acceptance criteria are well established and understood by the orthophotography vendor. Complexity derives from the large quantity of products to be reviewed and the specialized photogrammetric skills required. Risk is moderate to low based upon the established quality record of the orthophotography vendor.

Project Management and Organizational Structure

The orthophotography acquisition effort is managed by a team consisting of the VGIN program manager, a vendor project manager and a QA provider project manager. The QA provider will have direct contact with the orthophotography vendor; however, the VGIN program manager will be copied on all communications. The project management team holds weekly status calls and weekly status reports are provided when appropriate.

10. Scope of Work:

QA/QC will include a review and analysis of aerotriangulation; a review of ground control; a review of digital elevation models; a review of digital orthophotography; a review of final deliverables for completeness, format and readability, and review of completed corrections of edit calls to verify revisions meet VGIN Accuracy Standards . The 2017 eastern area acquisition is comprised of 12268 1’ digital orthoimagery (5000 x5000 ft) tiles covering approximately and 57 individual/client jurisdictions with jurisdictions potentially upgrading to either 0.5’ or 0.25’ as collection approaches.

Only a portion of the images will be reviewed following the requirements below:

a. 6-inch Upgrades : 14713 tiles
b. 3-inch upgrade: 3556 tiles
c. 1 foot off-year upgrade: 383 tiles
d. Additional Urban areas 695 tiles
e. Rural areas, 10% of 1-ft 1227 tiles
f. Total tiles 20574 tiles

In addition to the detailed review of the tiles as referenced below, the Supplier will still perform a macro level review of 100% of the tiles to identify any major voids or tonal variation between tiles. This task will be completed at a scale of 1:24000. This macro level review will be beneficial to the state to ensure that no major errors pass through the QC process that may impact the usability of the final imagery. Based on past experience, the Supplier has identified a number of voids within the products that may not be caught by reviewing only a percentage of the rural tiles. The cost of the macro level review is included in the overall cost and accounts for a minimal amount of the overall project cost.

METHODOLOGY

The required services are an extensive and detailed qualitative and quantitative review of
the 1', 0.5', and 0.25' 4-band stack digital orthophotography to include the following tasks:

A. Aerotriangulation (AT)

A.1. Review ground control locations within the block
A.2. Review ABGPS data (trajectory files)
A.3. Analyze sidelap
A.4. Display all tie points (TP) and passpoints (PP) and check for voids or irregularities
A.5. Review written report for completeness, accuracy, correctness
A.6. Review submitted data for completeness, readability and format
A.7. Review RMSE of control points, tie points and pass points
A.8. Review RMSE on blind points (collected by QAQC vendor or provided by the Commonwealth)
A.9. Prepare NSSDA accuracy sheet
A.10. Check Metadata

Deliverables: Interim documentation for each AT block will be provided of findings, passed or rejected data indicating the reason. A final AT block report will document final acceptance of the AT Block.

B. Ground Control

B.1. Review Ground control locations used in (AT)
B.2. Review NGS locations used as tie or base station
B.3. Review distance to HARN/NGS points
B.4. Review horizontal and vertical accuracy
B.5. Readability of Control Report
B.6. Review location sketch/image/description
B.7. Review GPS data for PDOP (Position Dilution of Precision)
B.8. Review GPS data for VDOP (Vertical Dilution of Precision)
B.9. Review time of GPS observations
B.10. Check Metadata

Deliverables: Documentation on the statewide adjustment and for each network will be provided of findings, passed or rejected data indicating the reason. A final report for the statewide adjustment and each network will document final acceptance.

C. Digital Elevation Model

C.1. Files are readable from source
C.2. Check for georeferencing (name vs. grid location)
C.3. Check for 3D coordinates (points and 3D lines)
C.4. Check for high/low points (spikes)
C.5. Check for voids (gaps)
C.6. Check for spacing
C.9. Check to make sure all requested tiles are delivered
C.11. Check Metadata.
C.12. Check files are readable in current version of ArcGIS (10.3.1 and greater)

Deliverables: Shapefiles that document findings for each tile including passed or rejected data and an indication of the reason. A report will document final acceptance of all tiles within each delivery group/area.

D. Digital Orthophotography (1 foot, 6 inch, and 3 inch GSD) on a tile by tile basis

D.1. Media is readable
D.2. Correct file format (4 Band – R,G,B,IR)
D.3. Tiles are georeferenced and appear in the correct location (tiff and MrSid)
D.4. Check GeoTIFF header against tfw (tiff world file)
D.5. Correctly defined projection information (tiff and MrSid) using (NAD_1983_HARN_StatePlane_Virginia_North_FIPS_4501_Feet
WKID: 2924 Authority: EPSG and
NAD_1983_HARN_StatePlane_Virginia_South_FIPS_4502_Feet
WKID: 2925 Authority: EPSG
D.6. Check pixel size
D.7. Review color/contrast against approved image chips
D.8. Check large areas for color balancing issues
D.9. Check color balancing between blocks of different resolution as defined by pilot projects
D.10. Check for image blemish and artifacts
D.11. Review mosaic lines -buildings and bridges, roads
D.12. Check for smears
D.13. Check for wavy features (roads and building roofs)
D.14. Check to make sure all requested tiles are delivered
D.15. Check for mismatch along seam lines and AT block seams (including blocks of different resolution)
D.18. Check Metadata

Deliverables: Shapefiles that document findings for each tile including passed or rejected data and an indication of the reason. A report will document final acceptance of all tiles within each delivery group/area. A report of horizontal accuracy will document results of independent check points within both state plane zones.

E. Digital Surface Model - is not intended to be a final product

E.1. Media is readable and uniform
E.2. Correct file format
E.3. Data is complete and no tiles missing
E.4 Check files are readable in current version of ArcGIS (10.3.1 and greater)

Deliverables: A report will document final acceptance of the Digital Surface Model. A report will document that the product is complete, readable and uniform with no tiles missing.

F. Final Deliverable Packaging Media (Jurisdiction and Statewide) Review:

F.1. Media meets design specifications
F.2. Media is readable -correct file formats
F.3. All Files are Readable in current version of ArcGIS
F.4. Media is complete-all appropriate information is provided

Deliverables: Interim document identifying any failures by package/media and final document certifying complete final acceptance of each deliverable package/media.

G. Independent accuracy assessment for localities.

G.1. Upon Request by VGIN or Locality only
G.2. Requestor will provide additional control at no cost to vendor
G.3. Check accuracy against blind check points and ground control points when control points are provided by localities
G.4. Prepare NSSDA report sheet

Deliverables: Ortho Summary Statistics and Ortho Horizontal Accuracy Results per NSSDA. VGIN will supply a sample report upon request. Historically only one or two localities have requested this type of review. It is expected to be less than five localities that may want this type of review.

ACCEPTANCE CRITERIA

Product acceptance criteria have been specified in the contract between VITA/VGIN and Fugro Geospatial, Inc (Fugro Services Contract 09232016). The Exhibit G – Acceptance Criteria is attached.

INDEPENDENT HORIZONTAL AND VERTICAL ACCURACY ASSESSMENT

For blind check points the Vendor will use existing and available ground control points that are not used in the control of the 2017 production. If insufficient control exists for horizontal accuracy assessments the Vendor may propose the acquisition of additional control points.

11. Period of Performance:

Implementation of the solution will occur within 1 Year of execution of this SOW. This includes delivery and installation of all products and services necessary to implement Authorized User's solution and any support, other than on-going maintenance services. The period of performance for maintenance services shall be 1 year after implementation and may be extended for additional 1 year periods, pursuant to and unless otherwise specified in the Contract.

12. Place of Performance (Check one):

☐ Authorized User's Location _____ *(City, VA)*

☒ Supplier's Location _____ *(City, State)*

☐ Authorized User's and/or Supplier's Location _____ *(Explain)*

13. Project Staffing

a. Supplier Personnel

The roles listed in the table below represent the minimum Supplier personnel requirements for this engagement.

Role	Key Personnel (Y/N)	Years of Experience	Certifications	References Required (Y/N)
Photogrammetrist/QA Specialist	Y	5		Y

b. Authorized User Staff

The roles listed in the table below represent Authorized User's staff and the estimated time each will be available to work on the project.

Role	Description	% Project Availability
Program Manager	Project oversight, tracking and acceptance	75%

14. Milestones and Deliverables:

The QA/QC Vendor will arrange work flows and schedules with VGIN and Fugro Geospatial, Inc to complete QA/QC of orthophoto and DEM tiles of the same percentages no later than 30
days after the corresponding delivery from Fugro Geospatial, Inc.

The minimum required milestones and deliverables and the estimated completion date for each deliverable are listed in the following table.

Milestone Event(s)	Deliverable(s)	Estimated Completion Date
1	QA/QC of ortho and dem products 15% cumulative delivery	July 31, 2017
2	QA/QC of ortho and dem products 35% cumulative delivery	August 31, 2017
3	QA/QC of ortho and dem products 65% cumulative delivery	September 30, 2017
4	QA/QC of ortho and dem products 100% cumulative delivery	October 31, 2017
5	All remaining products, reports, certifications and accuracy assessments.	October 31, 2017

Supplier should provide all deliverables in electronic form, using the following software standards (or lower convertible versions):

Deliverable Type	Format
Accuracy Assessment Report as shown in Methodology A:8	Word or PDF

15. Travel Expenses (Check one):

☐ No travel will be required for this engagement

☒ Travel must be included in the total fixed price of the solution

☐ Travel should be invoiced separately (with prior Authorized User approval). Supplier should provide estimate of total travel expenses in their SOW response.

16. Payment (Check all that apply):

☒ Payment made based on successful completion and acceptance of deliverables

☐ All payments, except final payment, are subject to a *15*% holdback

17. Acceptance Criteria:

The Project Manager will have *30* days from receipt of the deliverable to provide Supplier with the signed Acceptance Receipt.

Final acceptance of services provided under the SOW will be based upon (Check one):

☐ User Acceptance Test
Acceptance Criteria for this solution will be based on a User Acceptance Test (UAT) designed by Supplier and accepted by Authorized User. The UAT will ensure that all of the functionality required for the solution has been delivered. Supplier will provide Authorized User with a detailed test plan and acceptance checklist based on the mutually agreed upon UAT Plan. This UAT Plan checklist will be incorporated into the SOW.

☒ Final Report
Acceptance Criteria for this solution will be based on a Final Report. In the SOW, Supplier will define the format and content of the report to be provided to Authorized User for final acceptance.

☐ Other (specify): _____

18. Project Roles and Responsibilities:

Responsibility Matrix	Supplier	Authorized User
QA/QC Services	✓	
Required reports and certifications	✓	
Required accuracy assessments	✓	
Coordination of product deliveries from orthophotography vendor to QA/QC Supplier		✓
Review and acceptance of services, reports and certification		✓

19. Criminal Background Checks and Other Security Requirements:

Criminal Background Checks Required?

☒ *YES*

☐ *NO*

(Please provide details surrounding agency specific background check and/or other security requirements).

20. Performance Bond (Check one)**:**

☐ Required for *(XXX)*% of the SOW value

☒ Not Required

21. Reporting (Check all that are required):

☒ **Weekly or Bi-weekly Status Update**
The weekly/bi-weekly status report, to be submitted by Supplier to Authorized User, should include: accomplishments to date as compared to the project plan; any changes in tasks, resources or schedule with new target dates, if necessary; all open issues or questions regarding the project; action plan for addressing open issues or questions and potential impacts on the project; risk management reporting.

☐ **Other(s)** (Specify) _____

22. Federal Funds (Check one):

☐ Project will be funded with federal grant money

☐ Project will be funded with federal ARRA funds

☒ No federal funds or ARRA funds will be used for this project

23. Training and Documentation:

a. Training is:

☐ Required as specified below

☒ Not Required

Training Requirements:
(Specify specific training requirements)

b. Documentation is:

☒ Required as specified below

☐ Not Required

Documentation Requirements:
All reports specified in the scope of work

24. Additional Terms and Conditions:

The services to be provided are subject to the following additional provisions:

N/A

25. Scheduled Work Hours:

N/A

26. Facility and equipment to be provided by Authorized User:

Supplier to provide all hardware and software necessary to complete the task.

Compliance Checklist
SOW Appendix 2

True	False	Statement	Explanation
True		This response meets all requirements specified in the SOR and SOW. If NO, then list any limitations, constraints, or qualifications to the requirements.	
True		The Total Cost includes all costs for providing the services proposed in the SOW Response. If “False”, then list any other costs that the Requestor must acquire to accomplish the proposed SOW Response.	
True		The proposed cost includes the 8.68% MSP Fee. We understand that the Supplier will retain 8.68% of the total amount invoiced to the Authorized User.	
True		We nor any of our subcontractors are a party excluded from Federal Procurement and Nonprocurement Programs.	
	False	No portion of this effort will be subcontracted. If “False”, then list each subcontractor and the portion of the work that each subcontractor will perform.	To perform the SOW as currently defined the Supplier will not subcontract any portion of the work. However, should there be a need for additional ground control then the Supplier will hire a land surveyor to collect the needed points.
True		No exceptions are taken to the terms and conditions contained in the SOW. If “False”, please specify and explain any exceptions taken.	

Subcontractor Personnel Qualifications and References
SOW Appendix 3

TABLE 11: AECOM KEY PROJECT PERSONNEL						
Key Personnel	**Role**	**Years of Experience**	**Certifications**	**MD Statewide Ortho QA**	**FAA Plan/Topo/ Ortho/LiDAR QA**	**TINRS Ortho & LiDAR QA**
John Knowlton	Project Manager	16	PMP, GISP, ASPRS Certified Photogrammetrist	Y	Y	Y
Bobby Riley	QA Manager	18	PMP, ASPRS Certified Photogrammetrist	Y	Y	Y
Jesse Pinchot	Senior QA Analyst	10	GISP, ASPRS Certified Mapping Scientist	Y	Y	Y

John Knowlton, PMP, GISP, ASPRS CP

Project Manager

Total Years of Experience
16

Education
BS, Biology

Registrations/Accreditations
Certified Photogrammetrist, 1564
Certified Project Management Professional, 290756
Certified Geographic Information System Professional, 62070

Professional Affiliations
American Society of Photogrammetry and Remote Sensing (ASPRS)
Project Management Institute (PMI)

Mr. John Knowlton is experienced in all aspects of photogrammetric mapping, including: QA of vendor-supplied data, aerial data acquisition, control surveys, aerial triangulation, stereo map compilation, orthophotography, and LiDAR acquisition and processing. He has extensive project management and production experience with large, multi-year LiDAR, radar, orthophotography, planimetric and topographic mapping, and remote sensing contracts. Mr. Knowlton led the QA team on the 2010 North Carolina Statewide Orthophotography Project, as well as managed acquisition and processing projects for TNRIS, the USGS, the State of Maryland, and the National Geospatial Intelligence Agency.

Mr. Knowlton leads a diversified team of GIS and geospatial professionals that are responsible for a broad range of spatial data support services. Typical team projects involve geospatial program management services, geospatial quality assurance services, floodplain mapping support, LiDAR classification and derivative product generation, GIS database management, or photogrammetric data capture Mr. Knowlton has 16 years of experience in the GIS and geospatial industry. He has extensive experience in project/program management, geospatial/GIS production, communication, technical writing, and resource management.

Maryland Department of Information Technology, Maryland Digital High-Resolution Aerial Photography, Germantown, MD, Program Manager, 2012-2016. Responsible for the aspects of program management including client communication, technical Quality Assurance team management, issue resolution, stakeholder reporting, and schedule & cost controls. Main project deliverable is high-resolution orthophotography covering 7,000 square miles of the Western Shore in the state of Maryland. Buy ups under the contract include 3 inch imagery, LiDAR, and true orthophotography.

Texas Natural Resources Information System, High Resolution Elevation Data for Project Locations in TX, Germantown, MD, Quality Manager, 2012-2016. Mr. Knowlton is responsible for the administration and technical management of Quality Control and Quality Assurance Services for high resolution LiDAR terrain data. Responsibilities included, planning and management of QA checkpoint field surveys, aerial data vendor communication and coordination, qualitative checks of terrain data products, vertical and horizontal accuracy analysis, oversight of QA processes and technical staff, and all formal reporting.

FAA William J. Hughes Technical Center, 2015 GIS/Ortho/LiDAR Mapping, Quality Project Manager. Prepared the scope of work for geospatial data acquisition and processing. Was the lead certified photogrammetrist that ensured data was processed to ASPRS standards, ensuring appropriate accuracy within the final deliverables. Oversaw and participated in the review of raw and final GIS, ortho, LiDAR, topographic, and planimetric data deliverables. Performed a second round review of all generated edit calls and finalized quality team reporting. Worked closely with the FAA Technical Center to ensure all critical scope times were understood and provided within the final data.

Bobby Riley, PMP, ASPRS CP

Quality Assurance Manager

Total Years of Experience
18

Education
Diploma in Integration of GIS and Remote Sensing (Honors)
Diploma in Remote Sensing
BS, Biology

Registrations/Accreditations
ASPRS-Certified Photogrammetrist, MD, 1570
PMI Certified Project Management Professional (PMP), MD, 1720826

Professional Affiliations
American Society of Photogrammetry and Remote Sensing (ASPRS)
Project Management Institute (PMI)

Mr. Riley is experienced in all phases of photogrammetric mapping and QA processes, including aerial data acquisition, control surveys, aerial triangulation, stereo map compilation, orthophotography, and LiDAR acquisition and processing. Since 1997, Mr. Riley has worked on numerous photogrammetric projects encompassing the spectrum of geospatial mapping. He has overseen or served as task leader in hundreds of mapping projects from planning and acquisition, to processing and data QA. Mr. Riley oversaw the digital orthophoto and photogrammetric production efforts at the James W. Sewall Company, and subsequently oversaw orthophoto, LiDAR, planimetric and topographic acquisition, production, and QA projects while at Fugro and Supplier. For several years, he oversaw and facilitated specific offshore mapping efforts performed in a 200 technician facility in Qinhuangdao, China. This experience offered significant insight into the efficient detection of anomalies in digital orthoimagery, LiDAR, and vector based deliverables.

Maryland Dept. of Information Technology, Frederick County Planimetric Update Quality Assurance, Germantown, MD, Sr. GIS Specialist, 2014-2017. Review project deliverables to ensure scope compliance and fulfillment of project specifications. Data review includes comparative analysis of the updated planimetric mapping data against the 2014 Maryland West of the Chesapeake Orthophotography and project collection specifications. Detailed reports outlining deviations from the specifications were provided to the mapping vendor.

FAA William J. Hughes Technical Center, 2015 GIS/Ortho/LiDAR Mapping, QA Manager. Contributed to the scope of work for geospatial data acquisition and processing. Reviewed project data to assess conformance to project specifications and completeness of deliverables. Prepared interim project adherence reporting. Backchecked revised datasets to ensure vendor corrective actions were performed and meet project requirements. Participated in final report generation.

Texas Natural Resources Information System (TNRIS),High Priority Imagery & Data Sets (HPIDS), Germantown, MD, LiDAR Survey Quality Assurance Specialist, 2013 - 2017. Review project deliverables to ensure scope compliance and fulfillment of project specifications. Data review includes 4 band orthoimagery, LiDAR acquisition reports, developing and executing automated LiDAR processing routines, performing manual LiDAR point cloud, LiDAR Intensity, hydro-flattened digital elevation model, orthoimagery, and hydrological breakline reviews, anomaly detection and reporting, and spatial accuracy assessments.

2016 Planimetric Update Mapping Quality Assurance for the City of Austin, Texas, Germantown, MD, Planimetric Update/Revision Quality Assurance Specialist, 2016. Review project deliverables to ensure scope compliance and fulfillment of project specifications. Data review included horizontal accuracy and vertical assessments, Geodatabase structure and schema conformance, and planimetric revision update completeness review, including attribution verification.

Jesse Pinchot, ASPRS CMS, GISP

Quality Assurance Analyst

Total Years of Experience
10

Education
Bachelor of Science-Biology, University of Richmond, 2004
Graduate Certificate-Environmental Policy, University of Denver-University College, 2010

Registrations/Accreditations
2015, GISP/90257
2013, ASPRS Certified Mapping Scientist, GS265
2013, ESRI ArcGIS Desktop Developer Associate, EDDA1000000105
2011, ESRI ArcGIS Desktop Associate, EADA1000000327

Professional Affiliations
American Society of Photogrammetry and Remote Sensing (ASPRS)

Mr. Pinchot is a key member of the AECOM Spatial Data Solutions Team, a division of the Germantown Technology Solutions group. Mr. Pinchot is an ASPRS Certified Mapping Scientist, and also maintains a GISP and multiple ESRI certifications. His duties include client/vendor data management, geospatial workflow development, macro/micro QA production and documentation, report development, map production, application testing, and geoprocessing/automation development.

Maryland Dept. of Information Technology, Maryland Orthophotography, Germantown, MD, GIS Specialist, 2010 - 2017. Responsibilities on the project include uploading draft and final deliverables to image cache server, performing macro QA checks on draft and final deliverables, reviewing micro QA edit calls before/after correction, and ensuring final deliverables are complete and accurate before shipment to client.

Texas Natural Resources Information System (TNRIS), High Priority Imagery & Data Sets (HPIDS), Germantown, MD, GIS Specialist, 2010 - 2017. Review project deliverables to ensure scope compliance and fulfillment of project specifications. Data review includes 4 band orthoimagery, LiDAR acquisition reports, developing and executing automated LiDAR processing routines, performing manual LiDAR point cloud, LiDAR Intensity, hydro-flattened digital elevation model, orthoimagery, and hydrological breakline reviews, anomaly detection and reporting, and spatial accuracy assessments.

FAA William J. Hughes Technical Center, 2015 GIS/Ortho/LiDAR Mapping, GIS Specialist. Reviewed project data to assess conformance to project specifications and completeness of deliverables. Backchecked revised datasets to ensure vendor corrective actions were performed and meet project requirements. Analyzed 2011 and 2015 datasets to identify differences between the two data compilations.

US Army Geospatial Center, Urban Tactical Planner, Germantown, MD, GIS Specialist 2015 - 2016. Responsibilities on the project included GIS technical support, geodatabase design and management, workflow development, imagery analysis, and data production. Managed multiple ESRI SDE databases in a versioned editing environment. Provided quality control of data created by junior GIS Specialists. Digitized hydrologic features and topographic features from SRTM and imagery data.

FEMA Region VI, El Paso-Las Cruces Watershed Levee Natural Valley Analysis, Germantown, MD, GIS Specialist, 2015 - 2016. Responsibilities on the project included geospatial data development, geospatial data analysis, cartographic design, map production, and data quality control.

Subcontractor Qualifications and References
SOW Appendix 4

Strong Program Management Team. AECOM has experienced and strong geospatial program management professionals. Led by the AECOM Germantown, Maryland office our professionals have over 10 years of geospatial quality assurance experience and can support a broad range of geospatial services for federal, state, and local entities.

Bench Strength and Responsive Service. Our project team is prepared to respond quickly and efficiently. With several thousand personnel nationwide, including several hundred dedicated and certified geospatial professionals, AECOM is confident we can support this program in an extremely responsive manner.

Knowledge and Experience. AECOM is a recognized leader in geospatial quality assurance efforts. We offer nationwide experience in geospatial quality assurance for a variety of geographical datasets using differing acquisition sensor types at all levels of government. Our experience includes supporting geospatial quality assurance for the Federal Emergency Management Agency, U.S. Geological Survey, Federal Aviation Administration, and multiple state and local government entities. All key members of our proposed team members hold American Society of Photogrammetry and Remote Sensing (ASPRS) certifications and currently perform similar services for the State of Texas and the State of Maryland. They not only understand the datasets but the entire production process which is invaluable in understanding where geospatial errors can occur and how they might have occurred.

Budget and Timeframe Conscious. The AECOM team is not only well versed in geospatial datasets, but also in working in compressed project timelines. AECOM has made investments in software and systems to ensure that no project is ever slowed due to a lack of equipment or tools. The same commitment to preparedness extends to the AECOM pool of resources. Our geospatial team under the leadership of our PM, John Knowlton, contains 13 geographic information system staff that are cross trained to support the review process should the need arise. Communication is a key to any successful project and AECOM has a mature quality workflow that assures transparency and efficiency so all stakeholders understand the data and any findings.

AECOM has committed the best of its collective resources to provide the Authorized User with unsurpassed technical advantage and professional leadership in the niche field of geospatial quality assurance. The combination of our skills and best management practices provide the Authorized User a customized set of tested processes and techniques to ensure the Authorized User's specifications are met and provide what we believe will be the best possible solution to meet the services requested.

AECOM will be an active partner in this endeavor and is excited to assist the Authorized User achieve the program's quality assurance goals and objectives. AECOM's deep history and breadth of services, bolstered by project team leadership having years of firsthand experience in the challenges associated with digital orthophotography, planimetric collection, and LiDAR acquisition and production, provide a rock solid foundation to support and ensure Shelby County's project will be a success. Furthermore, AECOM's key team member experiences, industry insight, and relationships can be leveraged throughout the project to provide options, best practices, and guidance to the Authorized User.

AECOM salutes the Authorized User for recognizing the value and importance of soliciting geospatial quality assurance services as a means to protecting this considerable investment.

AECOM appreciates the opportunity of presenting our creative and cost effective QA approach and look forward to the prospect of partnering with the Authorized User on this very important project.

Relevant project experience and references below.

Digital High Resolution Aerial Photography (Orthophotography) for Maryland CATSII TORFP #060B1400054

Client
Maryland Department of Information Technology (DoIT)
100 Community Place
Crownsville, MD 21032

Services
Project Management
Geospatial Quality Assurance
Consulting

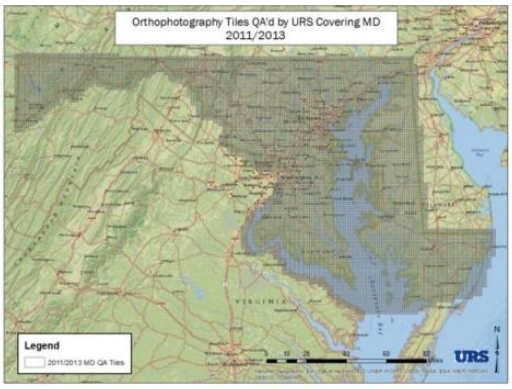
Project Value
$475,000

Completion Date
Ongoing

Key Contact Details
Lisa Lowe
Project Manager
T: 410.260.4043
E: lisa.lowe@maryland.gov

Project Overview

AECOM (legacy URS) has served as the Project Management and Quality Assurance (QA) service provider for the Maryland statewide orthophoto program on a continual basis since 2011. The work is contracted through Axis Geospatial who serves as the aerial mapping vendor. All work is performed under the direct supervision of an ASPRS Certified Photogrammetrist.



Project Management services include coordination of efforts between the Axis team members through all phases of the imagery acquisition and processing, and providing weekly status reports to the project stakeholders, as well as conducting project kickoff, pilot review, and close-out meetings. AECOM monitors all critical path project schedules and is instrumental in resolving all issues that arise in the course of the aerial mapping project.

Quality Assurance services include the following:

- Management and implementation of the macro/micro quality review processes for all imagery deliverables
- Final edit call reviews after complete stakeholder quality checks
- Review and acceptance of all formal reporting including; flight acquisition reports, ground control survey reports, and acceptance of aerotriangulation reports
- Final deliverable drive quality reviews
- Management of centralized edit calls geodatabase
- Macro & micro QA review of all buy up data including 3” imagery, true ortho imagery, LiDAR data, hydro breaklines, digital elevation models, and planimetric datasets

QA Web Tool
To expedite project communication and enhance project shareholder engagement AECOM developed and hosted a QA/QC web application that enables team members and stakeholders to easily and simultaneously view delivered ortho tiles and perform edit call markups. All edit calls are spatially aware, date stamped, includes the tile number, georeferencing, edit call type, and are stored in an ArcGIS geodatabase that centralizes all review and correction activities.

Because of high quality service, AECOM has recently been awarded the 2017 Orthoimagery Quality Assurance contract for Western Maryland commencing February 2017 for the State of Maryland.

Independent Quality Assurance in Texas for Texas Natural Resources Information System (TNRIS)

Client

Texas Water Development Board/TNRIS

1700 N. Congress
Austin, TX 78701

Services

Geospatial Quality Assurance

Project Value

$887,000

Completion Date

Ongoing

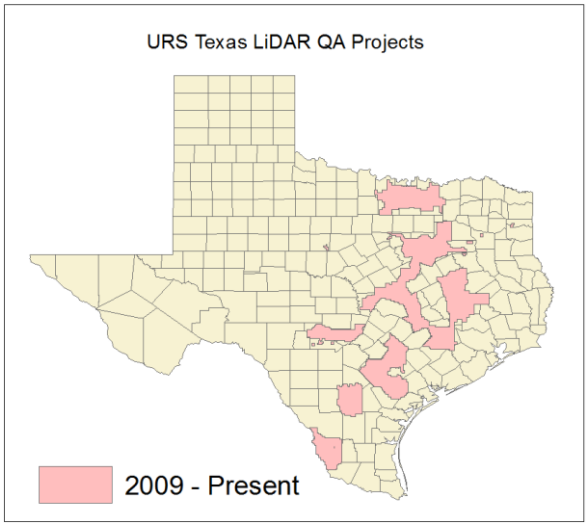
Key Contact Details

Felicia D. Retiz
Deputy GIO

T: 512.463.8862
E: Felicia.Retiz@twdb.texas.gov

Project Overview

AECOM (legacy URS) has maintained a healthy, longstanding, and successful relationship with TNRIS since 2009. This relationship spans 17 independent quality assurance (QA) task orders covering more than 30 counties in central Texas. Independent QA work focused on the review of vendor generated supplemental reports as well as LiDAR data and various derivative raster products. Raster product quality assurance assessments were performed on LiDAR intensity images and Digital Elevation Model (DEM) data. As such, AECOM has had substantial experience reviewing raster datasets, in particular elevation based raster datasets. Recently, AECOM completed a detailed review of 0.25' 4 band orthoimagery, QL1 LiDAR and DEM data for a small mine site in north eastern Texas.



Services

The Spatial Data Services Team was responsible for the following quality assurance consulting tasks:

- Management and implementation of the macro/micro quality review processes
- Procedures to ensure data deliverable completeness and compliance to project specifications as defined by the scope of work
- Review and acceptance of flight acquisition reports
- Review and acceptance of ground control survey reports
- Independent quality checkpoint survey
- Independent accuracy analysis
- Review and capture of data anomalies
- Detailed reporting on all findings

Because of high quality service, AECOM has recently been awarded 11,000 mi^2 of LiDAR Quality Assurance tasks for portions of Eastern, Central, and Coastal Texas commencing February 2017 for TNRIS.

2015 Update Mapping Effort for the Atlantic City Airport for the Federal Aviation Authority (FAA)

Client	Services	Project Value	Key Contact Details
William J. Hughes FAA Technical Center Building 294, Byrd Highway Atlantic City, NJ 08405	Project Management Geospatial Quality Assurance Consulting	$201,000 **Completion Date** 2015	Mac Walling FAA Program Manager T: 609.485.7420 E: mac.ctr.walling@faa.gov.com

Project Overview

AECOM, having successfully performed the most recent update in 2011, was again selected by the FAA to support the 2015 update mapping effort for the William J. Hughes Federal Aviation Administration (FAA) Technical Center in Fugro City, New Jersey. To commence this effort, AECOM initiated a competitive procurement process that resulted in the selection of Merrick & Company to perform the aerial mapping and production.

Deliverables included the following datasets:

- 2.5 cm 4 band orthoimagery
- QL1 LiDAR data
- FGDC metadata
- Planimetric and topographic updates delivered in Esri GDB and AutoCAD DWG formats
- Esri Terrain & TIN
- 1-foot contours
- All deliverables shared QL1 LiDAR data level accuracy requirements

Services

The AECOM Geospatial Data Services Team was responsible for the following quality assurance consulting tasks:

- Management and implementation of the macro/micro quality review processes
- Procedures to ensure data deliverable completeness and compliance to project specifications as defined by the scope of work
- Review and acceptance of flight acquisition reports
- Review and acceptance of ground control survey reports
- Independent quality checkpoint survey
- Independent accuracy analysis
- Review/capture/detailed report of data anomalies